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河南舞阳铁山庙式BIF铁矿的矿物学与地球化学特征及对矿床成因的指示

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摘要：

河南舞阳铁矿位于华北克拉通南缘。铁山庙式铁矿是舞阳铁矿的一部分,赋存于新太古界太华杂岩铁山庙组表壳岩中。本文根据铁山庙式铁矿中三种不同类型矿石(条带状石英-辉石-磁铁矿、块状辉石-磁铁矿、块状石英-磁铁矿)中磁铁矿的矿物成分、全岩/矿的主量元素及微量元素特征,探讨铁山庙式铁矿床的成因。磁铁矿单矿物成分分析表明,条带状石英-辉石-磁铁矿矿石中磁铁矿的FeO^T含量90.6%~93.1%,平均91.8%;块状辉石-磁铁矿矿石中磁铁矿的FeO^T含量90.7%~91.2%,平均91.0%;块状石英-磁铁矿矿石中磁铁矿的FeO^T含量92.0%~93.0%,平均92.4%。上述平均值均与磁铁矿FeO^T的理论值(93.1%)接近。三种类型矿石的其它元素如TiO_2、MgO、MnO、CaO、Al_2O_3、Cr_2O_3、NiO等含量均<0.1%,无明显区别,表明该区磁铁矿为含杂质极少的纯磁铁矿,表现出沉积变质成因磁铁矿的特征。矿石中斜方辉石-单斜辉石及近矿围岩紫苏辉石-长石-石英矿物组合,表明铁山庙式矿床经受了高级变质作用,石英、磁铁矿等矿物普遍发生变质重结晶,颗粒粗大,但仍保存原有的地球化学组成。元素地球化学分析显示,三种类型矿石中SiO_2、TiO_2、Al_2O_3、P_2O_5的含量相近;块状辉石-磁铁矿较其它二者相对贫铁、富钙、镁,这是由于块状辉石-磁铁矿石中富含铁普通辉石和铁次透辉石所致;矿石中TiO_2、Al_2O_3含量都极低,说明该区成岩成矿过程中未受到碎屑物质的混染。三种不同类型矿石的主量元素含量总体上都与世界典型BIF的相近。对于稀土元素,三种类型矿石均具有轻稀土亏损、重稀土富集($(La/Yb)_{PAAS}$=0.29~0.995<1),La、Eu、Y的正异常(La/La^*=1.10~1.89;Eu/Eu^*=1.30~2.23;Y/Y^*=1.47~1.84),较高的Y/Ho比值(39.7~51.3),具有现代海水及高温热液混合特征。因此,我们认为铁山庙式铁矿三种不同类型的矿石是极少受到陆源碎屑混染的化学沉积成因,虽遭受后期变质作用,但仍属BIF型铁矿。

英文摘要：

The Tieshanmiao-type iron deposit, part of the Wuyang iron deposit, is located at the southern margin of the North China Craton. The iron formation occurs in the supracrustal rocks of the Tieshanmiao Formation of the Neoarchaean Taihua Group. The chemical compositions of the magnetites and whole-rock samples from three types of ores (banded quartz-pyroxene-magnetite ore, massive pyroxene-magnetite ore, and massive quartz-magnetite ore) from the Tieshanmiao-type iron deposit are presented to investigate the ore-forming processes. The bulk chemistry of magnetite from different iron ore is as follows: FeO^T(total iron oxide) contents of banded quartz-pyroxene-magnetite ore range from 90.6% to 93.1% and the average is 91.8%. FeO^T contents of massive pyroxene-magnetite ore range from 90.7% to 91.2% and the average is 91.0%. FeO^T contents of massive quartz-magnetite ore range from 92.0% to 93.0% and the average is 92.4%. All these values are consistent with the theoretical FeO^T value of magnetite. TiO_2, MgO, MnO, CaO, Al_2O_3, Cr_2O_3 and NiO contents of the magnetites from different iron ores are all very low (<0.1%) without obvious variations among different types, suggesting that they are nearly pure magnetite, and typical of the banded iron formations (BIF). Mineral assemblages of ores (orthopyroxene+clinopyroxene) and host rock near orebody (hypersthene+plagioclase+quartz) indicate that the Tieshanmiao-type iron deposit has suffered high grade metamorphism. Quartz and magnetite became coarse-grained after recrystallization but still kept the original geochemical compositions. The three types of ores have similar SiO_2, TiO_2, Al_2O_3 and P_2O_5 contents. But massive pyroxene-magnetite ore have higher MgO, MnO and CaO contents than the others, due to the presence of abundant ferroaugite and ferrosalite in the massive pyroxene-magnetite ore. All the ores have very low TiO_2 and Al_2O_3 contents, suggesting clastic materials were not involved in the ore-forming process. They also have similar REE+Y patterns with LREE depletions ($(La/Yb)_{PAAS}$=0.29~0.995<1) and positive anomalies of La, Eu, and Y (La/La^*=1.10~1.89;Eu/Eu^*=1.30~2.23;Y/Y^*=1.47~1.84), characteristics of modern seawater and hydrothermal fluids from mid-oceanic ridges. Therefore, we conclude that the Tieshanmiao-type iron deposit can be classified as BIF despite of later-stage metamorphism.

关键词：条带状铁建造(BIF) 舞阳铁矿 铁山庙式铁矿 地球化学 前寒武纪 华北克拉通

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